

**AN EVALUATION OF FELSENTHAL AND
OVERFLOW NATIONAL WILDLIFE REFUGE'S
FOREST HABITAT MANAGEMENT PROGRAM'S**

REVIEW TEAM REPORT

SEPTEMBER 1990

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GENERAL REFUGE INFORMATION

FELSENTHAL

Physical Features

Public Law 91-111, signed by the President of the United States on December 31, 1970, authorized the acquisition of 65,000 acres of prime fish and wildlife habitat as an enhancement feature of the U.S. Army Corps of Engineers' (COE) Ouachita and Black Rivers Navigation Project. On August 12, 1975, land acquisition by the COE had progressed to the point that the property was a manageable entity and the Felsenthal National Wildlife Refuge (NWR) was officially established. For the next 10 years Felsenthal NWR was managed by the U.S. Fish and Wildlife Service (FWS) under an interim management permit from the COE. Finally, upon completion of essentially all mandated land acquisition, fee simple title to 64,813.34 acres of land and water on Felsenthal NWR was transferred from the COE to the FWS on November 18, 1985. Unfortunately, no oil and gas rights were purchased but all other outstanding mineral rights have been or are in the process of being acquired by the COE.

Felsenthal NWR is located in Ashley, Union and Bradley counties in southeast Arkansas, 53 miles west of the Mississippi River, 3 miles north of the Louisiana border and 8 miles west of Crossett, Arkansas.

Felsenthal's 65,000 acres consist of 3 basic habitat types: bottomland hardwood (39,000 ac.), pine-upland hardwood (11,000 ac.), and permanent water (15,000 ac.). The refuge lies within the Felsenthal Basin, a remnant of an enormous lake that once extended below Monroe, Louisiana. This low lying area is dissected by an intricate system of rivers, creeks, sloughs, buttonbush swamp and lakes throughout the vast bottomland hardwood forest. Drainage is generally in a southerly direction by the Ouachita and Saline Rivers which converge at the geographic center of the refuge. Historically, periodic flooding of the bottoms during late fall, winter and spring has provided excellent wintering waterfowl habitat.

On November 16, 1985, the COE began raising the permanent navigation pool to the required minimum 65.0' above mean sea level (MSL). Concurrently, flooding of the world's largest greentree reservoir (GTR) began, thus providing 15,000 acres of permanent water with the capability to flood an additional 21,000 acres for wintering waterfowl and related wetland species. These wetlands, in combination with the pine and upland hardwood forest habitat on the higher ridges, support a diversity of indigenous flora and fauna.

Climatology

The climate in south Arkansas generally consists of hot, humid summers and mild winters, with an average temperature and precipitation of 62.0°F and 57.4", respectively. For 1989 the annual average temperature was 61.5°F and precipitation for the year totalled 59.28", nearly 4 inches above the 10-year average.

<u>Year</u>	<u>Precipitation (inches)</u>	<u>Average Annual Temperatures (°F)</u>	<u>Temperature Extremes (°F)</u>	
			<u>Low</u>	<u>High</u>
1980	47.27	61.0	13	106
1981	42.49	60.4	10	103
1982	70.26	62.4	0	98
1983	52.22	60.0	3	99
1984	75.52	59.7	9	96
1985	43.10	63.3	3	101
1986	57.50	64.2	17	102
1987	54.35	62.7	21	99
1988	52.28	62.0	13	101
1989	<u>59.28</u>	<u>61.5</u>	3	96
Average	55.43	61.7		

Soil Types

Geologically speaking, the soils on Felsenthal are relatively young. The soils tend to range from silty loams to extremely fine sandy loams and silty clays. The predominant soil types in the uplands are the Amy-Felker Association, the Pheba series and the Bibb series. The predominant soil types in the hardwood bottoms are the Bibb series and the Chastain Association.

Vegetative Types

The upland forest cover types, or those types located above 72 feet above MSL, are; white oak-red oak-hickory (SAF Type 52), loblolly pine (SAF Type 81), and loblolly pine-hardwood (SAF Type 82). The bottomland types, or those types found to occur below 72 feet above MSL, are; sweetgum-Nuttall oak-willow oak (SAF Type 92), black willow (SAF Type 95), overcup oak-water hickory (SAF Type 96), and bald cypress-water tupelo (SAF Type 102).

Refuge forestlands are classified in four major types. There are 9,490 acres in the Pine type, 705 acres in the Pine-Hardwood type, 39,000 acres in the Bottomland-Hardwood type and 188 acres in the Upland Hardwood type.

Forest History

At the time land acquisition was initiated for Felsenthal Refuge, most of the land suitable for growing pine forests was managed intensively for the production of pulpwood, veneer bolts and sawlogs. Most of this land was stocked with large volumes of valuable pine.

Past management of the bottomlands consisted of either a clear-cutting operation at any time economical volumes existed, or a high-grading selective cut. Most of the refuge bottomlands that were formerly owned by the Potlatch Corporation and the Georgia-Pacific Corporation had been clear-cut within ten years of their acquisition date.

Before acquisition was initiated for Felsenthal, a decision was made to permit the five largest landowners with land involved in the project to reserve one-half of the volumes occurring on these holdings. These companies were the Georgia-Pacific Corporation; Olinkraft, Incorporated; Potlatch Forest; Calion Lumber Company and Deltic Farm and Timber. These five companies owned 92 percent of the refuge.

An agreement could not be negotiated with Potlatch personnel; therefore, the Potlatch forest lands were acquired, in their entirety, through condemnation.

The Olinkraft foresters elected to remove their company's share of the timber volume by harvesting all pine timber, 10 inches in diameter at breast height (DBH), that occurred on each alternating 40-acre tract. All other timber occurring on these lands was sold to the government.

Georgia-Pacific personnel reserved all merchantable pine that occurred on each alternating 40-acre tract. All hardwood was sold to the government.

The Deltic lands were stocked with high quality pine on their upland sites and adequate volumes of hardwood on their bottomland sites. Most of the hardwood had been removed from the refuge lands adjacent the Deltic properties. In an effort to preserve this needed hardwood habitat, a cutting pattern was negotiated with Deltic personnel that allowed their loggers to harvest most of the pine and reserved the better hardwood stands for the refuge.

After the Deltic lands were acquired, refuge personnel negotiated with Deltic personnel an exchange of pine sawtimber for the hardwood that occurred on Deltic's portion of the cutting pattern. Subsequently, refuge personnel exchanged pine that was owned by the government, with Deltic personnel for pine pulpwood that occurred on Deltic's part of the cutting pattern. This

exchange was limited to the pulpwood that occurred in manageable stands.

Calion Lumber Company is a hardwood lumber-producing organization; consequently, nearly all of the Calion lands were on bottomland hardwood sites and were stocked with big trees. Because of this, Calion's loggers were allowed to harvest their share of the timber by cutting all trees that were 20 inches DBH and larger.

After cutting operations were completed on the Calion lands, the area was stocked with an adequate volume of young trees and a large volume of cull (non-commercial) trees larger than 20 inches DBH. Approximately 30 percent of the residual volumes on the Calion lands consists of cull materials.

Since all trees growing in the permanent pool area would be killed at the time the pool was filled, the involved landowners were given the option of harvesting all timber growing in this area. Calion Lumber Company was the only landowner to exercise this option.

After cutting agreements were negotiated with the involved lumber companies, refuge personnel negotiated agreements with these companies to exchange refuge timber for trees containing cavities constructed by the red-cockaded woodpecker. After these cavity trees were located by company loggers, refuge personnel measured them and assigned an appropriate amount of refuge timber to the involved company. The trees with the cavities were then allowed to exist within the cutting area.

During acquisition negotiations, the lumber companies were given two options that limited the period of time of their cutting reservations. These options were a 2-year cutting reservation and a 4-year cutting reservation. The 4-year cutting reservation had a growth penalty for the last 2 years based on the annual growth of the area's forest and the appraised value of the timber. All lumber companies, excluding Calion Lumber Company opted for the two-year cutting reservation.

After the government received title to the Potlatch and Georgia-Pacific lands, refuge personnel began efforts to salvage the timber growing on that part of these properties located in the permanent pool area. A salvage sale consisting of 2,157 acres with 2,498, 440 board feet was sold on September 16, 1976. This salvage sale was located at the confluence of the Ouachita and Saline Rivers in Ashley and Bradley County. On August 16, 1977, 488,096 board feet of sawtimber growing on 240 acres was sold at Wheeler Lake in Ashley County. On April 17, 1978, another sale consisting of 2,944,662 board feet of sawtimber with 14,368 cords of pulpwood, growing on 5,065 acres was made near Red-eye Lake in Ashley County.

OVERFLOW NWR

Physical Features

Overflow NWR is located in southeast Arkansas in Ashley County, 5 miles west of Wilmot, 20 miles southeast of Crossett and 25 miles southeast of the Felsenthal NWR headquarters. Most of the land within the refuge boundary is classified as stream floodplain. Elevations vary from 90 to 110 feet above MSL and slopes are generally less than one percent. The western boundary basically follows the 110-foot contour along the Mississippi Alluvial Valley escarpment, an abrupt rise in elevation separating the Mississippi River Delta from the Upper Coastal Plain.

Overflow NWR was established November 6, 1980, to protect one of the remaining rapidly diminishing bottomland hardwood forests in the Lower Mississippi River Delta, an area especially important for wintering migratory waterfowl and nesting resident wood ducks. The refuge currently includes 9,963 fee-title acres within the proposed 18,100-acre project area, 69 acres under easement and 2,932 acres of leased waterfowl sanctuary on private lands.

Climatology

The climatological conditions on Felsenthal NWR generally apply to Overflow.

Soil Types

The soil types west of Overflow Creek are Calloway, Grenada, and Henry. The higher elevations are level to moderately sloping with loamy soils ranging from well drained to poorly drained. From Overflow Creek to the east boundary the soil types are Perry and Portland. These soils are clayey to loamy and range from level to poorly drained.

Vegetative Types

The predominant tree species on Overflow are the red oaks which occupy over 50% of the timber stand. The willow oak, which provides excellent food for mallards and wood ducks, is a major forest component. Bald cypress and tupelo gum are found along the stream channels, creeks, and sloughs. Overcup oak and bitter pecan are commonly found on the lower, poorly-drained sites and willow oak, sweetgum, and Nuttall oak are found next in the bottoms on the low ridges and flats. Some loblolly pine and

upland hardwoods occur on the higher elevations along the western boundary.

Annual flooding of the bottoms via a 4,000-acre GTR creates excellent wintering waterfowl habitat for mallard, wood duck, gadwall, teal, wigeon, and other waterfowl and wildlife species.

PROCEDURE

Forest habitat management program evaluations were conducted at Felsenthal and Overflow National Wildlife Refuges on August 14-16, 1990. The evaluations were the result of a Regional directive that all major forested refuges be evaluated to determine how successful each refuge has been in accomplishing Refuge, Region, and Service objectives. Another important part of this evaluation was to provide recommendations that will enable the refuge staff to better meet these objectives.

The evaluation team consisted of members with a thorough knowledge of the silvicultural requirements of bottomland hardwood tree species, habitat requirements for waterfowl, migratory birds, game, non-game, endangered species, and the administrative requirements for conducting refuge forest habitat management programs. Team members included Dr. John Hodges, Professor of Silviculture, Department of Forestry, Mississippi State University, with primary interests in the regeneration and management of bottomland hardwoods; Dr. Sydney Johnson with the Institute of Natural Resources, University of Georgia, with primary interests in the management of wildlife habitats and populations; Robert Johnson, Principal Silviculturist and Mensurationist at the Southern Hardwoods Laboratory, U.S. Forest Service, Stoneville, Mississippi (now retired); Ray Aycock, District Wildlife Management Biologist, USFWS; Chuck Hunter, Wildlife Biologist, USFWS, with emphasis on endangered and non-game species management; Skippy Reeves, Supervisory Forester and Regional Fire Management Coordinator, USFWS; and Clyde Stewart, Mississippi Valley District Forester, USFWS, serving as chairman of the review team. Don Adams, Senior Biologist, USFWS, could not be present during the evaluation to cover the administrative review so Skippy Reeves assumed this responsibility. Others present during the evaluation were Associate Manager Sam Drake, Refuge Manager Bridges, Refuge Biologist Ellis, Forestry Technician McDonald, Administrative Forester Threet and Assistant Manager West (present during Overflow NWR evaluation).

A presentation covering the management objectives for each refuge and present and past forest habitat management activities was presented by the refuge staff on the morning of August 14, 1990. The afternoon was spent in the field at Felsenthal NWR evaluating existing forest habitat conditions. The following five sites were looked at:

Stop #1. - A 620-acre stand of willow oak and sweetgum that had received a commercial thinning in 1988-89. The stand was about 35 years old with a few residual trees exceeding 80 years of age (Round Turn).

- Stop #2. - Part of the 1984 pre-navigation pool clearcutting between the 63- and 66-foot MSL contour (area north of Open Brake).
- Stop #3. - A young, relatively dense stand stocked predominately with overcup oak (between Hwy. 82 and Open Brake).
- Stop #4. - A 12- to 14-year old regeneration stand resulting from a clearcut operation in Shallow Lake.
- Stop #5. - GTR study plot and red-cockaded woodpecker colony.

On August 15, the team visited Overflow NWR. The following sites were visited at this station:

- Stop #1. - A relatively large area where bottomland hardwood timber has been killed due to beaver dams. The area is now stocked primarily with young black willow and buttonbush.
- Stop #2. - GTR where willow oak is undergoing considerable water-related stress.
- Stop #3. - Typical stand of bottomland hardwood west of Overflow Creek GTR water control structure.
- Stop #4. - A good stand of mature hardwood timber (Cemetery).

The review team met with the refuge staff Wednesday night (August 15) for an indepth discussion of existing management programs and to make recommendations to guide refuge personnel in future forest habitat management activities. Following the meeting with the refuge staff, and on the morning of August 16, team members prepared written sections (covering their area of expertise) to be incorporated in the Felsenthal and Overflow NWR's Evaluation Report.

FOREST HABITAT MANAGEMENT (SILVICULTURAL) PRACTICES

Introduction

One of the primary objectives of Felsenthal and Overflow Refuges is to provide high quality wintering and resident waterfowl habitat. From the standpoint of the bottomland hardwood resource, the most important aspect of habitat is the maintenance of a hard mast food supply. Thus, maintaining or increasing acorn production by the red oaks, primarily willow oak and

Nuttall oak, has to be a very important management goal. Refuge personnel have recognized this priority and have started management actions to favor the red oak component.

The major problems in managing the hardwood resource for wildlife habitat have to do with past cutting practices and with hydrology. Cutting practices before and shortly after establishment of the refuges have resulted in forests with very little age-class variation. A major goal, already recognized by refuge personnel, should be to initiate cutting practices which will insure better age-class distribution and vertical diversity.

The major detriment to achieving habitat goals through silvicultural practices has been and will continue to be regulation of water levels. On both refuges there has been a significant change in hydrology. This is greatly influencing both health and vigor of the standing trees and regeneration, especially of the more desirable red oaks. The red oaks, particularly willow oak, are declining in vigor and mortality is occurring. This trend is most pronounced on Overflow Refuge. A major problem, as recognized by refuge personnel, will be to find a way to regenerate the desirable red oaks in light of the change in hydrology of the sites.

Felsenthal NWR

The review team agrees with Refuge Forester Threet that the 40-acre clearcuts, as originally proposed, will not now be socially acceptable. We essentially agree with his silvicultural recommendations, but would suggest the following modifications: There should be no fixed rotation age and regeneration cuts should be small, ranging in size from 2-5 acres. This system would in essence be multi-age management, and would permit adequate light to favor the establishment of the less shade-tolerant red oaks.

In the mixed oak stands, similar to the ones we observed near the Saline River and which occupy about 19,000 acres of the Refuge, cuttings have been and should be used to increase diversity by improving age-class distribution. A major goal should be to maintain or increase red oak (willow and Nuttall) composition in future stands. The review team feels that this goal can best be accomplished with partial cuts (shelterwood) to enhance the establishment and growth of advance regeneration of red oaks. Once the regeneration reaches sufficient size to maintain its dominance, small regeneration cuts (2-5 acres in size) should be made to completely release the desirable species. In cases where there is a heavy understory and/or midstory, it may be necessary to eliminate these strata by cutting or use of herbicides to obtain advance regeneration of the desirable species.

Regeneration cuts should normally amount to no more than about one percent of the total forest acreage each year.

The major detriment to regeneration on these sites is the hydrological conditions. Natural regeneration of the red oak can be successful only if water levels can be controlled for a long enough period, perhaps 2-3 years, to allow the young seedlings to become established. This will necessitate effective beaver control as well as desirable water regulation by the Corps of Engineers.

The other major forest type on the Refuge is the overcup oak type--about 19,000 acres. These stands are on somewhat wetter sites (lower elevations) than the mixed oak type and are composed almost entirely of overcup oak with a scattering of Nuttall and willow oaks and green ash. The stand which we examined, and which is apparently typical of the type, was quite dense and was about 30 to 40 years old with a few older residual trees. Partial cuttings (thinnings) in these stands at this time are not necessary for stand development and it is doubtful that they would be commercial without severely overcutting the stand. However, thinnings could be used to open the stand for development of an understory for browse and other desirable seed-producing vegetation.

It is the opinion of the team that silvicultural treatments in these overcup oak stands are of a much lower priority than treatment of the mixed oak stands at Felsenthal and Overflow refuges. Where the overcup oak type occurs in very large tracts and more diversity is desirable, one option is to begin making regeneration cuts using small openings (2-5 acres). These areas will naturally regenerate very easily to overcup oak, but it would probably be possible to increase diversity and improve habitat by planting or seeding Nuttall oak in these openings. For this to be successful all competing vegetation above two inches in DBH should be removed.

When shelterwood or regeneration cuts are made to enhance the establishment and growth of regeneration in willow oak and overcup oak stands, we recommend that approximately 300 Nuttall oak acorns per acre be direct seeded prior to or immediately after timber harvest. Nuttall oak should compete favorably with the overcup regeneration, and increase diversity, in future stands.

It was noted by Service personnel that willow oaks along the border of the permanent pool area are dying and it was suggested that Nuttall oak seedlings might be planted in these areas. The team did not specifically examine such a situation, but it is a reasonable action which Refuge personnel could explore.

Overflow NWR

Tree species and stand conditions appear to be fairly uniform throughout the refuge. There are elm, water hickory, Nuttall oak, and a few other commercial species, but willow oak and overcup oak predominate. Two age-classes are generally represented. One class includes trees 6 to 12 inches in DBH. Trees in the other size class are usually 16 inches and above in DBH. Nearly all trees of merchantable size are very low in bole quality and have little potential for developing into valuable sawtimber. One reason for the poor condition of the stand is that past cutting practices have left numerous overmature and low vigor trees.

In addition to trees with low stem quality, trees, particularly willow oak, have considerable crown dieback. This is caused by several years of excessive flooding which, if left unchecked, will result in widespread tree mortality within 10 years or so. Therefore, we recommend that the 4,000 acre GTR not be controlled-flooded for at least 4 years in order to give the trees a chance to recover. We realize that late natural flooding (May-July) will continue to impact trees, but any beaver-induced flooding should be prevented.

Consideration should be given to establishing a flooding cycle for the GTR's at Overflow. Alternating annual flooding between the two or more GTR's will help to reduce water-related stress that is now causing tree mortality.

The refuge staff has not done any timber harvest, but it is time to do so. A new regeneration stand should be much more vigorous than the current one, provided flooding is limited to more normal patterns, i.e. December through March or April. Because this regeneration will not have been suppressed, these trees should exhibit better form and quality and be better acorn producers(eventually) than the ones growing today.

To prepare for management actions, the forest acreage should be cruised and condition-mapped. Information obtained during the cruise will determine the priority for implementing management actions. These actions should generally follow the guidelines already presented for Felsenthal. Essentially, where reproduction of good oak species is already established, it can be released in openings of 2 to 5 acres in size. Thinnings between openings should increase the establishment and early growth of desirable reproduction which can be released in cuts 10 or more years later. As a rule-of-thumb, about one percent of the area could be harvested annually. But, harvests should continue according to the needs of the forest and as man-power, markets, and site conditions permit. Due to the short period of time that forest habitat management activities can be implemented, because of wet conditions, management personnel

should fully utilize the dry periods to accomplish as much work as possible.

Since natural flooding can prevent harvest, we suggest first marking a segment of the GTR next to the water control structure and also a segment at the upper end of the GTR. If possible the lower section should be cut first to allow regeneration to grow large enough to survive when controlled flooding resumes. However, as pointed out in the preceding paragraph, the timber cruise should pinpoint specific areas that need immediate treatment due to stand conditions. The cruise should show where excessive tree mortality is occurring, sites where advance regeneration needs to be released and possible areas where TSI is needed to release more desirable tree species. When implementing forest habitat management actions and when conditions permit, these stands or sites should receive treatment based on their immediate needs rather than their locations.

To provide more species diversity and also to increase the component of more water-tolerant species, approximately 100 Nuttall oak seedlings should be planted per acre in the regeneration areas. Also, thought should be given to planting some pin oak (*Quercus palustris*) seedlings on some of the wetter sites since this species grows well on poorly drained flats. Overflow is a little south of the historic range of pin oak, however, thrifty pin oaks trees are growing in Crossett, Arkansas. Extensive planting of pin oak is not recommended at the present time. The seedlings could be planted prior to or immediately following timber harvest. Planting prior to timber harvest could possibly provide additional time for growth. Some of the seedlings will be damaged or destroyed during timber harvesting operations; however, an ample number of seedlings should be free to grow. In addition to the planting of seedlings, we also recommend that the regeneration areas be direct-seeded with about 300 Nuttall oak acorns per acre. This should be accomplished as soon as possible. Nuttall oak is recommended because it is suited to the site conditions and is an important mast producer.

When shelterwood cuts are made to encourage the establishment and growth of regeneration in both overcup and willow oak stands, we recommend that approximately 300 Nuttall oak acorns per acre be direct seeded on as many of these sites as manpower and time permits. This should be accomplished as soon as possible to enable the Nuttall oak seedlings to compete favorably with the overcup oak regeneration. Under natural conditions, the overcup oak component is going to increase both in and outside of the GTR due to hydrological changes. Direct seeding of the water-tolerant Nuttall oak acorns will help to achieve diversity and insure that the red oaks continue to be represented on the wetter sites.

Recommendations:

1. Regeneration cuts or openings should range in size from 2 to 5 acres.
2. A fixed rotation age should not be used in managing the forest.
3. A major goal should be to maintain or increase willow oak and Nuttall oak in future stands.
4. Partial cuts (shelterwood) should be used to enhance the establishment and growth of red oak regeneration. When the regeneration reaches sufficient size to maintain its dominance, the overstory should be completely removed with regeneration cuts 2 to 5 acres in size.
5. When a heavy understory or midstory of less desirable species occur on sites to be regenerated, these strata must be eliminated by cutting or with herbicides in order to obtain shade-intolerant red oak advance regeneration. Stems should be removed down to a two-inch diameter.
6. Regeneration openings should normally amount to no more than one percent of the total forest acreage each year.
7. Controlling water levels for 2 to 3 years will be necessary to obtain red oak regeneration large enough to withstand flooding. This will require effective beaver control on both refuges and water level regulation by the Corps of Engineers at Felsenthal.
8. Thinning of relatively young overcup oak stands (30-40 years old) to enhance overcup oak growth is not necessary at the present; however, in stands where considerable willow oak and Nuttall oak are present, overcup oak could be thinned to further the development of the red oak component.
9. Regeneration cuts can be made in overcup oak stands to increase diversity. Approximately 300 Nuttall oak acorns and 50 to 100 Nuttall oak seedlings could be planted per acre in these openings to improve wildlife habitat.
10. Nuttall oak seedlings could be planted along the border of the permanent pool where willow oaks are stressed and dying as a result of increased moisture conditions. Nuttall is more water-tolerant and probably would do fairly well on this site.
11. The 4,000-acre GTR at Overflow NWR should not be intentionally flooded for at least 4 years.

12. Intentional annual flooding of the GTR's at Overflow NWR should be alternated between GTR's to promote tree vigor.
13. Regeneration cuts should be made at Overflow NWR as soon as possible. Approximately 300 Nuttall oak acorns and 100 Nuttall oak seedlings per acre should be planted in the small regeneration openings (2 to 5 acres in size). Nuttall oak is more water-tolerant than willow oak and should do well on the wetter site.
14. Prior to implementing forest habitat management actions at Overflow NWR, the forest acreage should be cruised and condition mapped, and a Forest Habitat Management Plan and a Prescription be prepared.
15. Advance regeneration of willow oak and Nuttall oak should be released as soon as possible at Overflow NWR. Regeneration openings should be 2 to 5 acres in size.
16. Regeneration cuts should be conducted first on the lower sites (elevations) in the Overflow GTR's. This regeneration should be tall enough for the terminal bud to remain above water once intentional flooding of GTR is resumed.
17. Beaver control at Overflow NWR should be considered a high priority.
18. Thought should be given to planting some pin oak seedlings on the wetter sites at Overflow NWR.
19. A project should be initiated to clean out Overflow Creek by removing obstructions, sediment, etc. and to restore water levels to more historic, lower elevations in the channel.

FOREST HABITAT MANAGEMENT FOR WATERFOWL

Felsenthal NWR

Forest habitat management at Felsenthal is heavily oriented toward providing habitat for waterfowl since habitat for waterfowl is one of the primary refuge objectives. Emphasis on the importance of waterfowl habitat is further illustrated by the creation and subsequent management of the 21,000-acre GTR. The backbone of waterfowl species use of existing habitat is the mallard with wood ducks being a close second in total use days. Long-term indications are that diving ducks and other species which prefer open water habitat will become more common winter residents as the 15,000-acre permanent (navigation) pool opens up

as a result of dead and falling timber. Within the scope of this refuge objective we will focus our recommendations.

The predominate waterfowl habitat on Felsenthal is confined to flooded woodlands where waterfowl forage, rest, preen, and conduct other social activities. It is important that we protect and favor the red oak component of the forest because acorns from this group are preferred by waterfowl. The two primary species are Nuttall oak and the more prevalent willow oak. Hydrological changes brought about by the creation of the navigation pool have already had an undesirable impact on willow oak stands and will undoubtedly have an even greater impact in the future as water-induced stress continues to take its toll. For this reason it is important to continue the GTR monitoring study and to feature the more water-tolerant Nuttall oak in regeneration efforts. The alternative to the latter is encroachment by more water-tolerant non-oak species and the less desirable overcup oak.

Silvicultural treatments to perpetuate the red oak component are discussed in detail in the Silvicultural Section of this report. When implementing management actions, priority should be given to addressing the compartments within the 9,000-acre waterfowl sanctuary.

Forest opening management within the refuges bottomland hardwood component should be concentrated on existing openings such as the 72-acre moist soil field, the transition zone along the edges of the permanent pool where timber has been killed, along roadways, and right-of-ways. Dozer work and subsequent disking and bush-hogging as refuge priorities permit should be utilized to maintain and enhance this important habitat component which provides brood habitat for wood ducks, habitat diversity for other species of waterfowl and an alternative food source. The refuge staff is to be commended for its initial effort in this phase of habitat management.

Beaver ponds are numerous over the refuge, and add to important habitat diversity. These areas provide brood habitat for wood ducks, roosts for waterfowl such as wood ducks, and an alternative food source where moist soil plants have become established in drained ponds. Since hundreds of acres of this habitat exist within Felsenthal, the refuge should examine ways to manage this habitat type and exert a high priority effort on controlling beavers and removing beaver dams. No additional net loss of timber should be the refuge's objective in beaver management. Aerial seeding or hand-seeding Japanese millet in recently drained beaver ponds should be emphasized as time and funds permit. Monitoring of beaver ponds in early plant successional stages may eliminate the need for this activity if evidence is found of heavy exploitation of these sites by wild millet and other desirable annuals. A variety of plant

successional stages over the entire refuge beaver pond complex is desired.

Cavity encouragement should be an integral part of forest habitat management and should receive high priority attention during stand treatments. Analysis of existing cavities should be explored through contact with agencies such as the Mississippi State Cooperative Wildlife Research Unit.

The refuge's effort to encourage the U.S. Army Corps of Engineers to be more flexible with pool management is a great step toward enhancing existing waterfowl habitat and protecting the important forest resource. Efforts should continue to encourage the Corps to reduce the water level in the permanent pool at least one foot on a periodic basis. In addition, high and late water years should be followed with two or more year periods of non-GTR use to reduce water-related stress.

Overflow NWR

Overflow NWR is undergoing some long term hydrological changes that are detrimental to its forest resource. This problem is especially pronounced in the original 4,000-acre GTR. Fortunately, the creation of a new 1,200-acre GTR south of the existing facility offers an alternative that will provide some forest habitat for wintering waterfowl. The original GTR should be rested in a non-operational status for a period of four years. A third GTR is planned on the north end of the refuge, but is presently delayed by incomplete land acquisition. Emphasis should be placed on completing the acquisition of these tracts, either through actual purchase or flood easement. The immediate impact on total refuge waterfowl populations with alternating or cyclic flooding of GTR's will be cushioned somewhat since we now have extensive agricultural and moist-soil habitat. The overall benefits to waterfowl and other wildlife species will be enhanced since this management will result in a healthier forest.

Existing beaver ponds provide important habitat diversity and alternative food sources. However, beaver control is especially important at Overflow NWR because of adverse hydrological changes within the basin, as well as continued GTR use over a 15- to 20-year period. Existing timber stands can not stand any additional stress, therefore, beaver control should receive heavy emphasis. Successional variety is encouraged, but maintenance of beaver ponds is considered a low priority within the scope of overall refuge habitat objectives.

Reforestation at Overflow NWR should be concentrated on upper elevations where roadside screens are needed. Purchase of converted wetlands has been primarily designed to provide

alternative habitat in the form of moist soil or wetland-related agriculture.

Forest habitat management at Overflow NWR should consider maintenance and encouragement of cavities with special emphasis on those tree species which show a tendency to develop adequate cavities.

The red oak component should receive priority treatment during forest habitat management activities. Due to hydrological changes, this refuge has seen a shift toward wetter sites which are accepted by the more water-tolerant Nuttall oak. Unfortunately this species makes up a small component of the red oak group at Overflow. It should be favored in regeneration efforts and encouraged through artificial regeneration (direct seeding or seedlings).

Forest habitat management should favor willow oak and Nuttall oak because the acorns of these species are highly desirable as a source of food for waterfowl. Small regeneration cuts (2-5 acres in size) to perpetuate the shade-intolerant red oaks will also provide openings where wild millet and other desirable annuals for waterfowl should be present for several years.

Recommendations:

1. Management efforts should favor willow oak and Nuttall oak because acorns from these trees are preferred by waterfowl.
2. Continue monitoring GTR at Felsenthal NWR to determine vegetation trends.
3. The more water-tolerant Nuttall oak should be featured during regeneration efforts.
4. Compartments within the 9,000-acre waterfowl sanctuary at Felsenthal should receive priority when implementing management actions at Felsenthal NWR.
5. Management of bottomland forest openings at Felsenthal should be concentrated on existing openings such as the 72-acre moist soil field, around the edges of the permanent pool where tree mortality is occurring, along roadways, and rights-of-way.
6. Disking, bush-hogging, and dozer work should be accomplished to set back plant succession in the areas that are to be managed for waterfowl openings.

7. The refuge staff should examine ways to make beaver pond habitat more productive for waterfowl. Draining ponds and planting Japanese millet should be considered.
8. Controlling the beaver population and removing beaver dams at both refuges should be a top priority. No additional net loss of timber due to beaver activity should be a refuge objective.
9. Cavity encouragement and protection should receive high priority during stand treatments.
10. A study should be initiated to determine the number of desirable existing cavities present at Felsenthal.
11. Efforts should be continued to get the Corps to reduce the water level at least one foot in the permanent pool on a periodic basis. High and late water years should be followed by two or more year periods of non-GTR use to reduce water-related stress.
12. The 4,000-acre GTR at Overflow NWR should not be intentionally flooded for a period of 4 consecutive years.
13. Intentional flooding of individual GTR's should be alternated annually at Overflow NWR.
14. Roadside screens are needed at Overflow. This should be accomplished by reforestation.
15. Small regeneration cuts (2-5 acres in size) will provide temporary openings where wild millet and other desirable annuals will provide additional food for waterfowl.

FOREST HABITAT MANAGEMENT FOR ENDANGERED SPECIES

Felsenthal and Overflow Bottomlands.

The only known endangered species to occur in and around open water, riverine, and bottomland habitats is the bald eagle. Presently, about six birds are found on each refuge during winter. With the development of an expanded pool size at Felsenthal in 1985, the number of wintering eagles is expected to increase. Although no nesting has been attempted on either Felsenthal or Overflow, there are suitable trees available (mostly cypress at Felsenthal) for nest placement. When a nest is found on either refuge, measures must be taken to minimize

disturbance from the public and from management activities as prescribed in the Service's bald eagle habitat management guidelines. Establishing a 200-foot wide buffer strip on Felsenthal along major waterways, emphasizing overmature hardwoods with large DBH, will serve to provide for additional roosting and future nest sites.

If other threatened or endangered species are located on either refuge where forest management actions are proposed, then an informal intra-Service Section 7 consultation is required to minimize or avoid inadvertent impacts to those species.

Felsenthal Uplands.

The only listed species that occurs in the Felsenthal upland forests is the endangered red-cockaded woodpecker. The staff of Felsenthal are to be commended for their work and dedication in conducting sound habitat management for this species. The team was particularly impressed with the interest taken by the staff in studying biological attributes of this species, especially the banding effort. Results from ongoing studies conducted by refuge staff may enhance our abilities to manage for this species in the long-term in southeastern Arkansas.

The team visited only a few colony sites, but all of these were in very good shape. We concur with the observations made by Fish and Wildlife Enhancement personnel in 1986, that colony site management is superb. Reproduction is high (3-4 young fledged per year among colonies checked) and some new colonies have been located in recent years on the refuge.

Despite the optimism expressed by the team for the woodpeckers at Felsenthal, all is not well for the species elsewhere in southeastern Arkansas. By all accounts, habitat loss on private lands is accelerating and there is no way of knowing how many colonies exist or how many will be lost in the near future. This situation presents some serious challenges to Felsenthal's small, albeit healthy, population.

The most serious short-term problem is that Felsenthal's population will become more and more isolated. Isolation for an effective breeding population of about 30 pairs is borderline for losing genetic diversity through inbreeding depression. Little can be done through habitat management on the refuge that is not already being done to solve this problem in the short-term. The team observed some stands that had a very high stocking level and heavy hardwood encroachment in the understory and midstory. Additional hardwood control (principally in the understory and midstory) and thinning of pines in these stands may provide for future colony sites and possibly better quality foraging habitat

than at present (the banding study should help to determine whether these stands are used more often than would be expected by the team members). The team recommends at least a two-year burning cycle for colony sites where fuel is sufficient to carry a fire hot enough to kill or set back undesirable vegetation. Colony sites which have limited fuel can continue to be burned once every three years.

Also, the team concurs with the refuge staff that there is a need to break up the present checkerboard pattern that has stands greater than 60 years old alternating with stands less than 15 years old in 40-acre blocks. Sections of the stands less than 15 years old should be considered for pulpwood removal to allow for balancing age-classes. However, special attention must be given to long-term management of existing foraging habitat for each colony. This must include consideration of how much habitat is expected to be suitable for foraging in 15 years and how much existing foraging habitat may be lost to natural mortality of loblolly pines greater than 80 years old (the banding study may help determine how important hardwoods are to foraging woodpeckers, thus allowing for some degree of error in projections). All considerations for treatments involving woodpecker habitat must be included in an informal intra-Service Section 7 consultation before implementation by using the Service's guidelines for preparing a biological assessment for this species.

Additional coordination with Fish and Wildlife Enhancement may include using experimental techniques to enhance the Felsenthal population. Methods of developing artificial cavities have greatly improved in recent years. This technology can be used to allow new colony formation in areas where suitable or potentially suitable foraging habitat exists but is presently not used by woodpeckers. Translocation procedures have also greatly improved the Service's ability to manage genetic diversity of small populations. Mr. Gary Henry, the Service's red-cockaded woodpecker species coordinator, may be contacted at the Asheville Enhancement Field Office for more information on these and other management techniques if the refuge staff so desire.

Finally, as habitat loss outside the refuge boundary accelerates, there is an ever increasing need to work with private landowners. The team believes that the best way to approach private landowners and reach cooperative agreements would be through financial incentives. Another possibility would be through the Service's land acquisition process, to include conservation easements, but our lack of understanding of where colonies persist may negate such an effort without the cooperation of the landowners. The team recommends that Fish and Wildlife Enhancement take the initiative for pursuing contact with adjacent landowners through organizations such as The Nature Conservancy and the Society of American Foresters. These two

groups could serve as intermediaries in any negotiations that would result in either cooperative agreements or land acquisition. The refuge staff may also be able to develop this possibility by discussing them informally with neighboring landowners who may be receptive.

Recommendations:

1. When bald eagle nests are found, measures must be taken to minimize disturbance from the public and from management activities as prescribed in the Service's bald eagle habitat management guidelines.
2. Red-cockaded woodpecker colony sites should be prescribed burned every two years when possible.
3. The existing checkerboard pattern of 40-acre blocks of timber should be broken up to create a better balance of age-classes. Special attention must be given to long-term management of existing foraging habitat for each woodpecker colony.
4. All management actions involving woodpecker habitat must undergo an informal intra-Service Section 7 consultation prior to implementation.
5. The team recommends that Fish and Wildlife Enhancement take the initiative to protect woodpecker habitat on private lands through financial incentives or through the Service's land acquisition process.
6. A 200-foot wide buffer strip of overmature hardwoods should be established along major waterways for bald eagle nesting and roosting sites.

FOREST HABITAT MANAGEMENT FOR NONGAME WILDLIFE

Migratory Birds (Felsenthal)

The management objective of diversifying stand composition and age structure in the Felsenthal bottomland forest will benefit or will be compatible with most nongame migratory birds occurring on the refuge. Team recommendations to initially thin stands to 70 square feet of basal area per acre to allow the development of regeneration should greatly add needed dimensions to the forest not presently found, while not affecting overall habitat needs of canopy species using the forest in its present condition. In

addition, regeneration treatments in 2- to 5-acre blocks should benefit some early successional bird species such as yellow-breasted chat, while being compatible with forest-interior species, such as yellow-billed cuckoo, eastern wood pewee, and wood thrush. These latter species have shown serious widespread declining trends within the Upper Gulf Coastal Plain as well as elsewhere within the Service's Southeast Region.

There is a critical need for the development of a larger size class (greater than 30 inches DBH) component, allowing for fuller canopies, in all stands visited by the team for the benefit of canopy species such as cerulean warbler. This species is a Service species of national management concern and is generally thought to be the most declining neotropical migrant occurring in Southeast bottomland forests. Opportunities may exist to enhance this species' status within Felsenthal as forests mature. This species prefers closed canopied forests and nests at heights in excess of 40 feet. No less than 1,750 acres of contiguous forest appear to be required for this species to occur, thus there is an ample land base within Felsenthal to support populations of cerulean warbler if their preferred habitat is developed. Song surveys for this species should be conducted in May or early June to determine where this species occurs on the refuge and to document the habitat condition of the stands used for breeding.

An important concern for forest-interior birds, including some of those mentioned above, is that forest openings attract brown-headed cowbirds (a nest parasite) and nest predators, which may severely disrupt nesting attempts of birds in adjacent forested patches. Present biological information suggests that forest-interior species are unable to maintain their populations within 1/8 mile of forest edges, which include agricultural lands, major roadways (including wide refuge roads), and utility right-of-ways. There is little agricultural land adjacent to Felsenthal bottomlands so most permanent edge situations will be along roadways and right-of-ways. Cowbirds and some avian nest predators (i.e., common grackle) are considered abundant on Felsenthal and their effectiveness in disrupting nesting efforts of forest-interior species is contingent upon their ability to penetrate forest habitat from edges. The further a nesting bird is from an edge, the less likely it will fail due to parasitism or depredation; thus the fewer the edge situations there are, the lower the impact will be on forest-interior species.

An important consideration in forest habitat management is to avoid isolating forest tracts so that they are bordered on most or all sides by roadways, right-of-ways, or other large openings within 1/8 mile. Attention must be given also to forestry activities adjacent to the refuge; the team recommends that forest habitat management should avoid forest fragmentation within 1/8 mile of the forest edge to discourage brown-headed cowbird activity. Very small regeneration openings (2-5 acres) are unlikely to contribute significantly to cowbird or

depredation problems on forest-interior species at Felsenthal given attention to land-use patterns both within and surrounding the refuge. Openings from one cutting cycle should not influence the location of future regeneration openings.

Removal of beaver dams is critical for maintaining the health of Felsenthal's bottomland forest. Removing beavers is strongly encouraged for nongame migratory birds requiring forested habitats. In addition, draining beaver ponds in late summer will concentrate small fish and large invertebrates that serve as important prey items for post-breeding herons, egrets, and wood storks.

Overflow Bottomlands.

The same general considerations expressed for Felsenthal bottomland management also apply to Overflow. However, the management needs for this forest and the surrounding land use patterns are very different. Most of the bottomland forest on Overflow is within 1 to 2 miles of an extensive agricultural area on the east-side of the refuge. The west-side is bordered by upland hardwoods and pine forest. In this situation, regeneration treatments may best be accomplished by concentrating activity rather than dispersing activity throughout the forest during any one cycle. Order of entry should possibly be from south to north with most management activity during the first cycle being concentrated in the lower portions of the GTR where trees are probably stressed the most. The second cycle would then concentrate management activity into areas expected to hold the next most stressed stands, and then progressively up the GTR in subsequent cycles. Perhaps similar activity could start in a second (upper end of the GTR) area to allow for years when entry into the most stressed stands is restricted. The concept here is to avoid many scattered cuts throughout the forest that would further fragmentation. Fragmentation will be influenced greatly by the extensive forest-agricultural edge already existing on the refuge. However, this cutting regime is dependent upon the condition of all stands within the forest, with those stands needing the most attention receiving treatments first regardless of location. However, attempts should still be made to treat large contiguous stands needing immediate treatment first over widely scattered small stands also needing immediate treatment.

As with Felsenthal, the potential land base (forest size) exists for cerulean warblers to occur and breed successfully. The area near the "Cemetery" was the most suitable site for supporting this species that was visited by the team. Song surveys should be conducted at Overflow to determine whether cerulean warblers actually occur on this refuge. Certainly the desired forest structure and species composition that should result from

proposed management would be beneficial to this and many other nongame migratory birds in the future.

Natural regeneration of willow thickets, especially within recently removed beaver ponds, should provide important nesting and foraging habitat for a number of insectivorous birds. Dense willow thickets also provide good foraging habitat for insectivorous species during migration as many such birds concentrate their activities in these woodlands along waterways. The potential also exists for willows to support nesting Bell's vireo, another Service species of national management concern.

Felsenthal Uplands.

Management for red-cockaded woodpecker in the pine and pine-hardwood stands also serves to benefit several other nongame migratory birds. Hardwood control and frequent burning should serve to benefit the Bachman's sparrow, a species of national management concern and a Service candidate for federal listing as a threatened or endangered species. The primary habitat used by this species is open pine woodlands with dense ground cover but little or no understory. Development of ferns and bunch grasses with regular burning seems optimal for this ground nesting species, especially when the overstory is composed primarily of pine. Densely stocked pine or pine-hardwood mix woodlands with little or no ground cover or with a well-developed understory are avoided by this sparrow.

Recently regenerated stands (less than 15 years old) also serve to benefit other nongame migratory birds found to be undergoing severe declines throughout the Southeast Region. These early successional stands, which unavoidably include a hardwood understory, should provide habitat for prairie warbler and field sparrow. Proposed management to balance pine age-classes should provide additional habitat for these species. In essence, pine management that is concentrated on the needs of the red-cockaded woodpecker has inherently built-in management to benefit other nongame, as well as game species associated with a diversity of open and semi-open situations.

Other Nongame Species On Both Felsenthal and Overflow.

The goal of diversifying forest types in both species composition and structural types (including vertical and horizontal patchiness) should benefit a good diversity of animals and plants throughout both refuges. A presently proposed study that would include investigating snag and cavity use by wildlife on Felsenthal should provide important information for future management of snags in the bottomland forest. Snags larger than 30" DBH were rarely observed in the stands visited on Felsenthal,

while only some were observed on Overflow (these were concentrated in the "Cemetery" stand). The team anticipates that large snags will increase naturally as a significant stand component consisting of large trees develops within the bottomland forest.

Interpretative.

The visitor center exhibits at Felsenthal provide a good review of the diversity of forested habitats and how they are managed on the refuge. One of the most important goals of the national wildlife refuge system is to strike a balance for a diversity of wildlife including some species or groups of species that may have conflicting needs. The team believes that both Felsenthal and Overflow management is presently striking this balance that should only improve with the proposed management actions.

However, greater emphasis in some of the exhibits perhaps should be placed on how forest management is based and modified on the needs and considerations of many wildlife species. Specifically, the exhibit on forest openings is correct for pine management and for game species in general; however, many forest-interior nongame birds in bottomland hardwoods would be harmed if the forest opening concept was to be overapplied. In this case, it may be prudent to point out that forest openings are designed in such a way to provide maximum benefit to a large number of species while being compatible with species not attracted to these habitats.

Management Studies.

A recent forest review of White River National Wildlife Refuge recommended that a management study include an assessment of brown-headed cowbird use of forest stands under various management regimes. The team believes that White River may be more susceptible to problems from cowbird parasitism than Felsenthal, because of its surrounding land-use patterns (much more agricultural land surrounding White River). Recommended bottomland hardwood management at Felsenthal is not significantly different from that at White River, in terms of fragmentation or size of areas treated, and therefore results from a White River study should add insight into forest management at Felsenthal. If results at White River indicate that there may be problems with cowbirds negatively affecting forest-interior birds throughout treated stands, then a closer look at forestry practices at Felsenthal (and Overflow) may be warranted.

Recommendations:

1. Regeneration openings, 2-5 acres in size, should benefit some early successional bird species and also be compatible with forest-interior species.
2. Some stands should be thinned to approximately 70 square feet of basal area per acre to enhance the establishment and growth of regeneration. This should not adversely impact canopy species.
3. Song surveys can be conducted in May or June to determine where the cerulean warbler occurs on the refuge.
4. Forest habitat management should avoid creating openings within 1/8 mile of the forest edge to discourage brown-headed cowbird invasion.
5. Beaver control must be accomplished to protect nongame migratory bird habitat.
6. A few beaver ponds should be drained in late summer to concentrate small fish and large invertebrates for consumption by post-breeding herons, egrets and woodstorks.
7. The same general considerations expressed for Felsenthal bottomland hardwood management are recommended for Overflow.
8. Concentrating regeneration treatments during any one cutting cycle will help to avoid forest fragmentation. However, this cutting regime is dependent upon the condition of all stands within the forest, with those stands needing the most attention receiving treatments first regardless of location.
9. Natural regeneration of willow stands, especially in beaver ponds, should provide important nesting and foraging habitat for insectivorous birds.
10. Upland pine and pine-hardwood habitat management should strive to create a better balance of age-classes to enhance habitat for a greater variety of wildlife species.
11. The refuge staff should review the brown-headed cowbird study recommended for White River NWR once it has been completed. If the results indicate a problem at White River, a closer look at Felsenthal's forest habitat management program may be warranted.
12. Thought should be given to modifying an exhibit in the visitor center to emphasize how forest habitat management is conducted primarily to meet the needs of endangered species

and waterfowl while still considering the needs of other game and nongame species.

FOREST HABITAT MANAGEMENT FOR GAME SPECIES

Bottomland hardwoods, the dominant forest type on the refuges and the primary focus of this review, contribute in several ways to the welfare of game species. But, because the bottomlands are flooded for a significant part of the year, they cannot meet the year-round needs of upland game. The primary value of the bottomland hardwoods to upland game is that they provide a source of high-energy food--acorns and other mast--during the fall, before flooding. Current silvicultural practices and the modifications recommended by the review team are directed toward encouraging growth of red oaks to provide food for wintering waterfowl. These practices will also benefit deer, turkey, squirrels, and raccoon (and bear should they become established on the refuges). Declining vigor of oaks caused by prolonged flooding is a major concern, and the review team recommends that water not be impounded (Overflow 4,000-acre GTR) in the fall before natural flooding occurs, at least for a period of four years. Delaying flooding in fall will have a secondary benefit of extending the period of availability of mast for upland game.

Small regeneration cuts (2-5 acres) are recommended to provide better dispersion of age-classes. Also, greater diversity of mast-bearing species--including overstory and understory trees, shrubs, and woody vines--should be promoted to the extent practical. The abundance of overcup oak provides a buffer against failures in the red oak acorn crop, but other buffer mast species are needed, especially considering the declining vigor of the red oaks with increased water stress. Greater diversity would benefit waterfowl as well as other wildlife. Regeneration openings should promote diversification of species, but desirable mast-bearers other than oaks should be retained when thinning stands. These would include species such as ash, sweetgum, elm, sugarberry, blackgum, persimmon, maple, hornbeams, grapes, and rattanvine.

Another important contribution of bottomland hardwoods is cavities for squirrels and raccoon as well as cavity-nesting ducks and non-game birds, and perhaps bears in the future. Availability of cavities should be no problem on these refuges, except possibly very large dens for bears. Potential bear dens should be reserved when timber is being cut.

The open understory and lack of herbaceous ground cover limits the value of bottomland hardwoods for deer and turkey in summer.

As the forestry program is intensified, thinnings and regeneration areas should provide increased groundcover in a continually changing pattern. Beaver-killed areas and small openings resulting from hydrologic changes will also produce desirable groundcover. However, succession in beaver-impounded areas will progress to thickets of willow and buttonbush shading out the ground cover which is more desirable for game species. Recognizing that willow thickets are important as nesting and foraging habitat for many nongame species, a few of the more accessible thickets nevertheless may be disturbed periodically by mechanical or other means to arrest or set back succession. This procedure would allow the reestablishment of ground cover that will benefit other wildlife species. Although beaver impoundments are desirable habitat for ducks and other wildlife species, additional loss of bottomland hardwoods to beavers is undesirable, and intensive beaver control should be continued.

Because of the flooding regime and lack of understory in the bottomlands, upland habitats probably are crucial to game other than waterfowl on the refuges. Most of the wild turkeys probably are produced on the uplands and use the bottomlands mainly for feeding on mast in fall and for roosting. Deer, squirrels, and raccoon also concentrate on adjacent uplands when the extensive bottomlands are flooded. On Felsenthal Refuge about 90% of this upland is pine, where the needs of the red-cockaded woodpecker have top priority. Management practices for the red-cockaded woodpecker will be compatible with increasing quality of turkey nesting and brood-rearing habitat and year-round habitat for bobwhite quail. These practices should favor the fox squirrel, perhaps at the expense of the gray squirrel. They should provide adequate, but not optimum, deer habitat.

Management of the uplands was not reviewed in detail, but some tentative impressions and suggestions are offered. On Felsenthal Refuge much of the pine type consists of two age-classes arranged in a checkerboard pattern. Work should begin soon in the young age-class to break up this pattern and create new age-classes. This could be delayed until some of the timber reaches commercial size, depending upon how long that will be. Cutting in the older age-class should be limited to corners of the blocks where some cutting may be necessary to consolidate portions of two or more young stands into a new age-class. Some of the young stands should be thinned heavily, possibly by prescribed fire, and portions of them incorporated into older stands.

Prescribed burning evidently was not a common practice on the area before the establishment of Felsenthal Refuge. The Refuge has accomplished much in a short time with this tool. Allowing fires to feather out without firebreaks creates a mosaic of conditions and should be continued. Prescribed fire has been used very effectively at red-cockaded woodpecker colony sites. However, some other sites seemed to need a more aggressive use of

fire. The review team recommends more varied burning practices be tried. More frequent (annual or biennial) burning in some areas, especially red-cockaded woodpecker colony sites where intensive hardwood control is desired, would promote a grassy groundstory that would provide brood-rearing areas for turkeys and benefit open pine woods species such as the fox squirrel and Bachman's sparrow. Also, burning at seasons other than the winter is being used elsewhere much more frequently than in the past to accomplish different objectives and diversify lesser vegetation. The review team recommends that experimental warm-season burning be tried on some small areas.

Habitat quality for deer and turkey could be improved by additional permanent openings, especially if winter forages were established in them. However this is not recommended because Refuge resources are limited, and other needs have far greater priority. Also, continued thinning and burning of the pine type should result in a steadily increasing groundcover of grasses and forbs that will provide many of the benefits of permanent openings. Existing openings, rights-of-way, and road shoulders should be maintained by mowing as necessary.

Recommendations:

1. Do not flood greentree reservoirs before natural flooding occurs in fall or winter; allow oaks to recover from excessive flooding.
2. Use small (2- to 5-acre) regeneration cuts to provide better dispersion of age-classes.
3. Focus management on red oaks but encourage diversity of mast-bearing species.
4. Reserve potential large den trees.
5. Where practical, arrest succession in some of the beaver-impounded areas by mechanical disturbance.
6. Continue efforts to control the beaver population.
7. Break up the checkerboard pattern and diversify age-classes in the pine type, mainly by working in the young stands.
8. Diversify the burning program with some annual or biennial burning and experimental warm-season burning in a few small areas.
9. Maintain existing openings, rights-of-way, and road shoulders by periodic mowing but give low priority to establishment of additional permanent openings.

ADMINISTRATION

The administration section of this review focused primarily on funding, staffing, and equipment needs. As with most refuge field stations, the funding at Felsenthal NWR/Overflow NWR comes from several different sources, some of which are very specific in their parameters.

Staffing

The work load on a refuge complex of this type is substantial, complicated, and the necessary field work is limited because of routine flooding. One forester and one forest technician are currently on the staff. Plans are to convert the forestry technician to the forester series. To relieve some of the problems associated with achieving annual objectives, we recommend adding two FTE's to the staff. We believe this staffing addition should be either forest technicians or GS-5/7 foresters. We prefer the forester scenario, as the refuges will provide excellent training in both bottomland hardwoods and pine thus providing a needed pool for career FWS foresters.

The team is somewhat concerned by the perceived lack of coordination and communication between the forestry and biological personnel. This could be an incorrect observation. However, if this is the case, we encourage these disciplines to blend together to insure all facets of management are considered. It is extremely important to have these disciplines working together in planning and implementing the land management program.

Equipment

Refuge equipment is well-maintained and stored under sheds. No needed critical forest management equipment was identified. The staff has a good understanding of the methods of acquiring funding from both fire and forestry accounts.

When portions of the refuge are flooded, boats serve as the only means of transportation to reach ridges or high ground where management practices need to be accomplished. At the present time forestry personnel use boats and motors to accomplish this. When replacing this equipment, thought should be given to replacing a portion of these items with expense for sales funds if available.

The location of beaver dams and ponds prior to foliage discoloration is essential if the forest on these sites is to be maintained in a healthy condition. Early detection is hard to

accomplish using fixed wing aircraft. One possible solution would be to use the Service helicopter, if funds could be designated. Possibly some of the refuges close to Felsenthal/Overflow could pool their resources for several days of detection work.

The refuge has only one computer system. For all practical purposes this is being used primarily for word processing and is not available for land management activities. We recommend that a computer dedicated to management activities be purchased. This system should have the capacity to utilize data bases and mapping systems.

Fire Management

Fire management operations are excellent. The staff is trained in basic fire fighting as required, with the Administrative Forester trained to the crew boss level. Fire planning and reporting procedures are understood and followed. Safety equipment is adequate for the staff. The refuge has a seasonal fire crew that is directly supervised by the Forester. The Forester has considerable knowledge and interaction with the Refuge Manager concerning the management of the refuge fire budget. This is the procedure the team recommends.

Prescribed fire in the uplands is currently being utilized in red-cockaded woodpecker management. Recommendations for altering the burning cycle are located in the wildlife section.

General Administration

The Forest Habitat Management Plan for Felsenthal NWR was completed in 1979 and should be updated. We recommend this be accomplished by amendments if the updates are not too extensive. This should be accomplished during periods when field work is not possible.

A Forest Habitat Management Plan for Overflow NWR and a Habitat Management Prescription are necessary before any forest management is initiated. The Plan and Prescription should be prepared as soon as possible.

Recommendations:

1. Two FTE's should be added for forestry work.
2. The forestry and biological personnel should work closely together when planning and implementing forest habitat management practices.

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6. The Forest Habitat Management Plan for Felsenthal NWR needs to be updated. If the updates are not too extensive, this can be accomplished by amendments.
7. A Forest Habitat Management Plan and a Forest Habitat Management Prescription should be prepared for Overflow NWR as soon as possible. This has to be accomplished prior to initiating forest management activities.

SUMMARY

The complexity of bottomland hardwood habitat management is magnified at Felsenthal and Overflow NWR's due to several factors. The primary ones are:

1. The short period of time that management personnel have to accomplish forest habitat management actions. During the last 3 years, personnel have been able to work only about 12 months in the field due to late flooding and wet conditions. This constraint mandates that personnel plan and schedule office and field work to best utilize their time. This is especially true with the current level of staffing.
2. Cutting practices by former landowners prior to Government acquisition have resulted in forests with little age-class distribution. This will be corrected over a period of time with the implementation of recommendations outlined in this report. However, due to the limited amount of acreage adequately stocked with healthy trees in the older age-classes, several years will be required to achieve optimum habitat conditions.
3. Beaver control work requires considerable effort on almost all of our bottomland hardwood refuges. This is especially true at Felsenthal and Overflow Refuges where several hundred acres of beaver ponds now exist. The present beaver population, coupled with the change in hydrology (acreage becoming wetter), requires that the refuge staff give beaver control efforts a high priority when planning management actions.
4. Considerable tree mortality is occurring on each refuge due to water-related stress. The sites (especially the lower elevations) are generally becoming wetter. As a result of this, there is a shift toward wetter site species. At the present time we do not know the exact impact that this is going to have on future forest cover type acreage. However, we do feel that this will give us an opportunity to establish some of the more water-tolerant red oak species such as Nuttall and pin oak on some of these sites. The recommendations for accomplishing this are adequately covered in this report.

The refuge staff is commended for the work that has been accomplished in managing red-cockaded woodpecker colonies. The interest and concern for this bird is evidenced by the sound, habitat management practices that are now in place at Felsenthal. Another area that deserves special recognition is that of forest opening management. Refuge personnel are aware of the value of forest openings for many wildlife species,

especially waterfowl and have taken steps to create and maintain this component of wildlife habitat in a fashion that is compatible with other wildlife species not using forest openings.

The refuge staff is also commended for the work that has been accomplished in the area of timber sales. During the past 3 years, water conditions have made it possible to spend only about 12 months in the field conducting forest habitat management activities. During this period approximately 1,000 acres of hardwood timber was marked and 400 acres of pine was thinned. This work was in addition to considerable remarking that was necessary due to excessive flooding.

The development of levees, moist soil areas and the farming program at Overflow NWR looked very good to the team. Ducks and geese apparently have found Overflow to their liking also as evidenced by waterfowl use days. This is very important because not all is well with Overflow's forests, especially the 4,000-acre GTR. We may be approaching a point where willow oak mast is going to decline sharply.

During the review it was readily apparent that we are facing some real problems at Overflow NWR. The willow oaks in the GTR are showing signs of extreme stress. Mortality is occurring, the foliage is chlorotic in appearance and there is a large amount of crown dieback. Recommendations are outlined in this report that hopefully will restore tree vigor, however, it is doubtful that the stand can be restored to its original healthy state. Once trees are stressed from excessive water to the point that crown dieback is common they seldom fully recover.

The present staffing pattern is not adequate to handle the workload at Felsenthal and Overflow Refuges. In order to accomplish management objectives two FTE's should be added for forestry work in the near future. Until this happens, it is very important that the Refuge foresters devote all of their time to forest habitat management activities during the relatively short period of time when field work can be accomplished.

SUMMARY OF RECOMMENDATIONS

BOTTOMLAND HARDWOODS

Forest Management (High Priority)

1. Regeneration cuts or openings should range in size from 2 to 5 acres to ensure a good component of desirable tree species that are shade-intolerant and provide better dispersion of age classes. These openings will provide temporary openings for waterfowl feeding and brood rearing and should benefit some early successional bird species while still being compatible with forest-interior species.
2. Forest habitat management should avoid creating openings within 1/8 mile of the forest edge to discourage brown-headed cowbird invasion.
3. Focus management on red oaks but encourage diversity of mast-bearing species, including midstory and understory species.
4. A major goal should be to maintain or increase willow oak and Nuttall oak in future stands because acorns from these trees are preferred by waterfowl and also Nuttall oak is a more water-tolerant species.
5. Partial cuts (shelterwood) should be used to enhance the establishment and growth of red oak regeneration. When the regeneration reaches sufficient size to maintain its dominance, the overstory should be completely removed with regeneration cuts 2 to 5 acres in size.
6. When a heavy understory or midstory of less desirable species occur on sites to be regenerated, these strata must be eliminated by cutting or with herbicides in order to obtain shade-intolerant red oak advance regeneration. Stems should be removed down to a two-inch diameter.
7. Controlling water levels for 2 to 3 years will be necessary to obtain red oak regeneration large enough to withstand flooding. This will require effective beaver control and water level regulation by the Corps of Engineers.
8. Nuttall oak seedlings could be planted along the border of the permanent pool where willow oaks are stressed and dying as a result of increased moisture conditions. Nuttall is more water-tolerant and probably would do fairly well on this site.

9. The 4,000-acre GTR at Overflow NWR should not be intentionally flooded for at least 4 years.
10. Intentional annual flooding of the GTR's at Overflow NWR should be alternated between GTR's to promote tree vigor.
11. Regeneration cuts should be made at Overflow NWR as soon as possible. Approximately 300 Nuttall oak acorns and 100 Nuttall oak seedlings per acre should be planted in the small regeneration openings (2 to 5 acres in size). Nuttall oak is more water-tolerant than willow oak and should do well on the wetter site.
12. Prior to implementing forest habitat management actions at Overflow NWR the forest acreage should be cruised, condition-mapped, and a Forest Habitat Management Plan and a Prescription be prepared.
13. Advance regeneration of willow oak and Nuttall oak should be released as soon as possible at Overflow NWR. Regeneration openings should be 2 to 5 acres in size.
14. A 200-foot wide buffer strip of overmature hardwoods should be established along major waterways for bald eagle nesting and roosting sites.
15. When bald eagle nests are found, measures must be taken to minimize disturbance from the public and from management activities as prescribed in the Service's bald eagle habitat management guidelines.

Forest Management (Medium Priority)

1. Regeneration openings should normally amount to no more than one percent of the total forest acreage each year.
2. Thinning of relatively young overcup oak stands (30-40 years old) to enhance overcup oak growth is not necessary at the present, however, in stands where considerable willow oak and Nuttall oak are present, overcup oak could be thinned to further the development of the red oak component.
3. Thought should be given to planting some pin oak seedlings on the wetter sites at Overflow NWR.
4. Regeneration cuts can be made in overcup oak stands to increase diversity. Approximately 300 Nuttall oak acorns and 50 to 100 Nuttall oak seedlings could be planted per acre in these openings to improve wildlife habitat.

5. Regeneration cuts should be conducted first on the lower sites (elevations) in the Overflow GTR's. This regeneration should be tall enough for the terminal bud to remain above water once intentional flooding of GTR is resumed.
6. Continue monitoring GTR at Felsenthal NWR to determine vegetation trends.
7. Compartments within the 9,000-acre waterfowl sanctuary at Felsenthal should receive priority when implementing management actions at Felsenthal NWR.
8. Cavity encouragement and protection should receive high priority during stand treatments. Potential large den trees should receive special consideration.
9. A study should be initiated to determine the number of desirable existing cavities present at Felsenthal.
10. Concentrating regeneration treatments during any one cutting cycle will help to avoid forest fragmentation, however, this cutting regime is dependent upon the condition of all stands within the forest, with those stands needing the most attention receiving treatments first regardless of location.

Forest Management (Low Priority)

1. A fixed rotation age should not be used in managing the forest.
2. Some stands should be thinned to approximately 70 square-feet of basal area per acre to enhance the establishment and growth of regeneration. This should not adversely impact canopy bird species.

Openings Management (Medium Priority)

1. Management of bottomland forest openings at Felsenthal should be concentrated on existing openings such as the 72-acre moist soil field, around the edges of the permanent pool where tree mortality is occurring, along roadways, and right-of-ways.
2. Disking, bush-hogging, and dozer work should be accomplished to set back plant succession in the areas that are to be managed for waterfowl openings.
3. Roadside screens are needed at Overflow. This should be accomplished by reforestation.

Water Level and Beaver Management (High Priority)

1. Efforts should be continued to get the Corps to reduce the water level at least one foot in the permanent pool on a periodic basis. High and late water years should be followed by two-year periods of non-GTR use to reduce water-related stress.
2. Controlling the beaver population and removing beaver dams at both refuges should be a top priority. No additional net loss of timber due to beaver activity should be a refuge objective.
3. Natural regeneration of willow stands, especially in beaver ponds, should provide important nesting and foraging habitat for insectivorous birds.
4. Develop a project to move water through Overflow Creek unobstructed and at a level commensurate with the historic water table prior to siltation from nearby agricultural practices.

Water Level and Beaver Management (Medium Priority)

1. The refuge staff should examine ways to make beaver pond habitat more productive for waterfowl. Where practical, arrest succession in some of the ponds by mechanical disturbance. Draining ponds and planting Japanese millet should be considered.
2. A few beaver ponds should be drained in late summer to concentrate small fish and large invertebrates for consumption by post-breeding herons, egrets and woodstorks.

UPLAND HARDWOOD - PINE FOREST

Forest Management (High Priority)

1. The existing checkerboard pattern of 40-acre blocks of timber should be broken up to create a better balance of age-classes. This should be accomplished mainly by working in the young stands. Special attention must be given to long-term management of existing foraging habitat for each woodpecker colony.

Fire and Red-Cockaded Woodpecker Management (High Priority)

1. Diversify the burning program with some annual or biennial burning and experimental warm-season burning in a few small areas.
2. Red-cockaded woodpecker colony sites should be prescribed burned every two years when possible.
3. All management actions involving woodpecker habitat must undergo an informal intra-Service Section 7 consultation prior to implementation.

Fire and Red-Cockaded Woodpecker Management (Medium Priority)

1. The team recommends that Fish and Wildlife Enhancement take the initiative to protect woodpecker habitat on private lands through financial incentives or through the Service's land acquisition process.

Opening Management (Medium Priority)

1. Maintain existing openings, rights-of-way, and road shoulders by periodic mowing but give low priority to establishment of additional permanent openings.

GENERAL

Non-game and Visitor Center (High Priority)

1. The refuge staff should review the brown-headed cowbird study recommended for White River NWR once it has been completed. If the results indicate a problem at White River, a closer look at Felsenthal's forest habitat management program may be warranted.

Non-game and Visitor Center (Medium Priority)

1. Song surveys can be conducted in May or June to determine where the cerulean warbler occurs on the refuge.
2. Thoughts should be given to modifying an exhibit in the visitor center to emphasize how forest habitat management is conducted primarily to meet the needs of endangered species and waterfowl while still considering the needs of other game and nongame species.

ADMINISTRATION

(High Priority)

1. Two FTE's should be added to the staff for forestry work.
2. The forestry and biological personnel should work closely together when planning and implementing forest habitat management practices.
3. The Forest Habitat Management Plan for Felsenthal NWR needs to be updated. If the updates are not too extensive, this can be accomplished by amendments.
4. A Forest Habitat Management Plan and a Forest Habitat Management Prescription should be prepared for Overflow NWR as soon as possible. This has to be accomplished prior to initiating forest management activities.
5. A computer having the capacity to utilize data bases and mapping systems should be purchased and assigned to the forestry and biological staff.

(Medium Priority)

1. Boats and motors are used in conducting forest habitat management work. When replacing a portion of this equipment thought should be given to using expense for sale funds.
2. Explore the possibility of using the Service helicopter to locate new beaver ponds prior to foliage discoloration.